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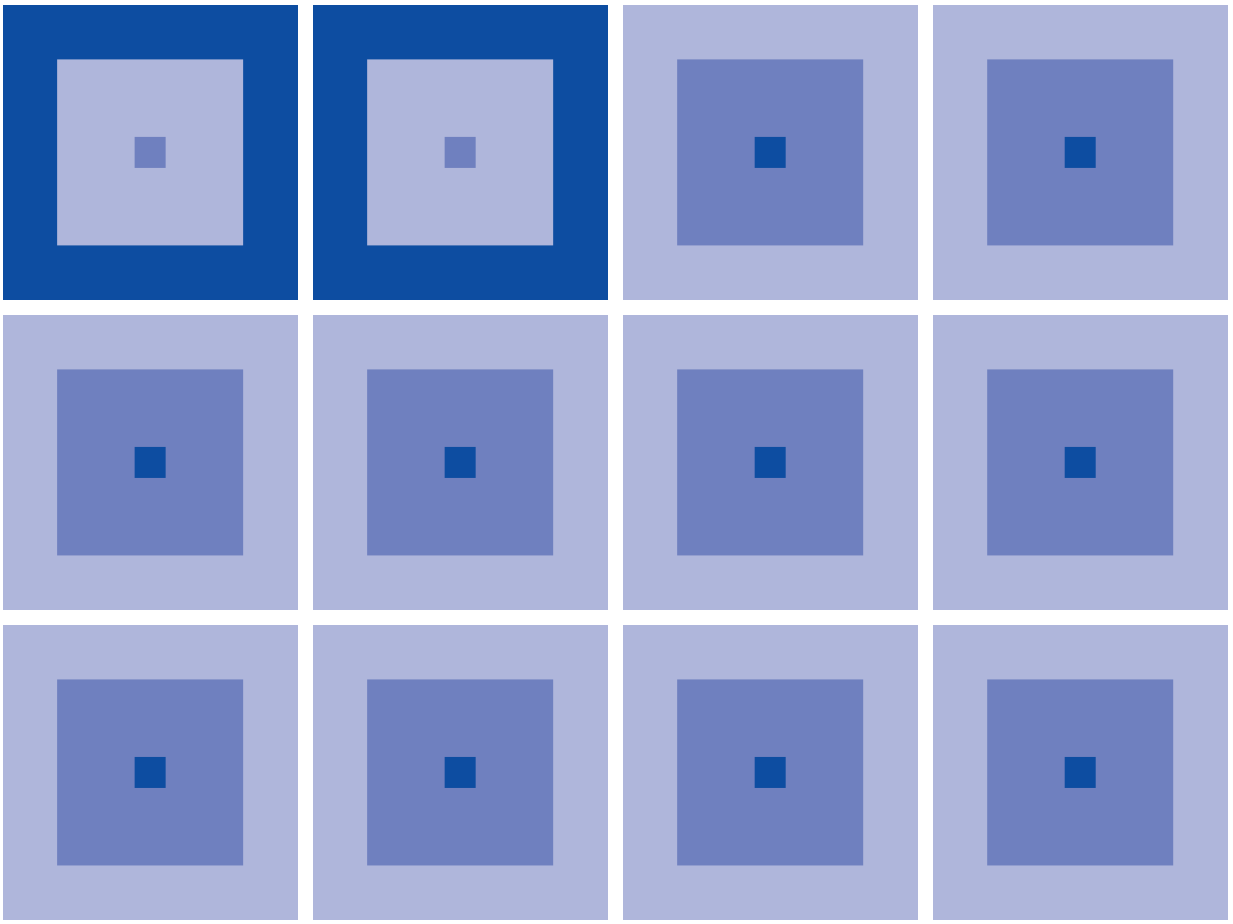
EPSON

CMOS 4-BIT SINGLE CHIP MICROCOMPUTER

S5U1C60N15E Manual

(Evaluation Board for S1C60N15)

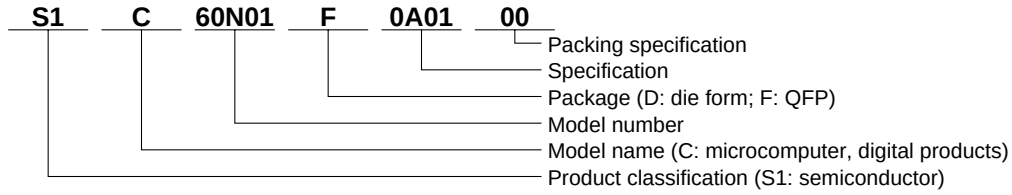


SEIKO EPSON CORPORATION

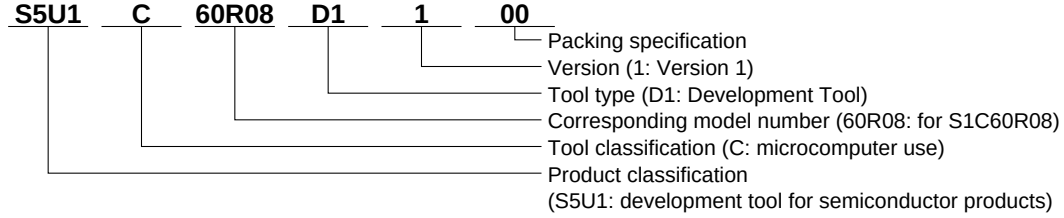
New configuration of product number

Starting April 1, 2001, the product number has been changed as listed below. Please use the new product number when you place an order. For further information, please contact Epson sales representative.

Devices



Development tools



S5U1C60N15E Manual (Evaluation Board for S1C60N15)

This manual describes how to operate the S5U1C60N15E, a debugging tool for the S1C60N15 4-bit, single-chip microcomputer.

Refer to the "S1C60N15 Technical Manual" for details of the S1C60N15, and the "S5U1C62000A Manual" and the "S1C60/62 Family Development Tool Manual" for the development procedure and other information.

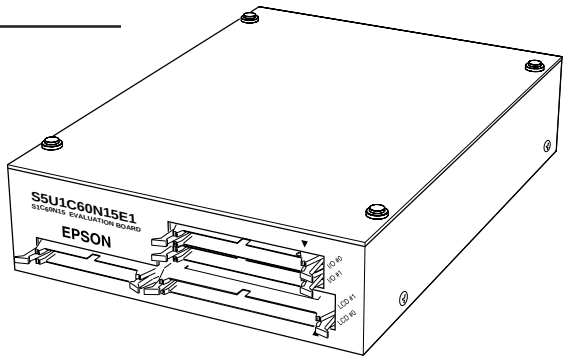
Contents

1 INTRODUCTION

1.1 S5U1C60N15E Outline

The S5U1C60N15E is a development tool for the S1C60N15.
Almost the same functions that the S1C60N15 CPU has can be implemented by writing application program and option data created by the option generator into EPROM, and installing it in the S5U1C60N15E.

In addition, the S5U1C60N15E can interface with the in-circuit emulator ICE (S5U1C62000H), and so perform a higher level of debugging.



1.2 S5U1C60N15E Components

When unpacking the S5U1C60N15E, check that the following goods are present:

(1) S5U1C60N15E main unit 1
(2) LCD connection cable and connector (60-pin flat type) ..... 1 set
(3) I/O connection cable and connector (50-pin flat type) ..... 2 set
(4) Power cable (3-pin) ..... 1 set
(5) Fuse (3 A) 1
(6) S5U1C60N15E Manual (Evaluation Board for S1C60N15) (this manual) 1
(7) Warranty registration card 1
(8) Warranty certificate 1
(9) Notes on use 1

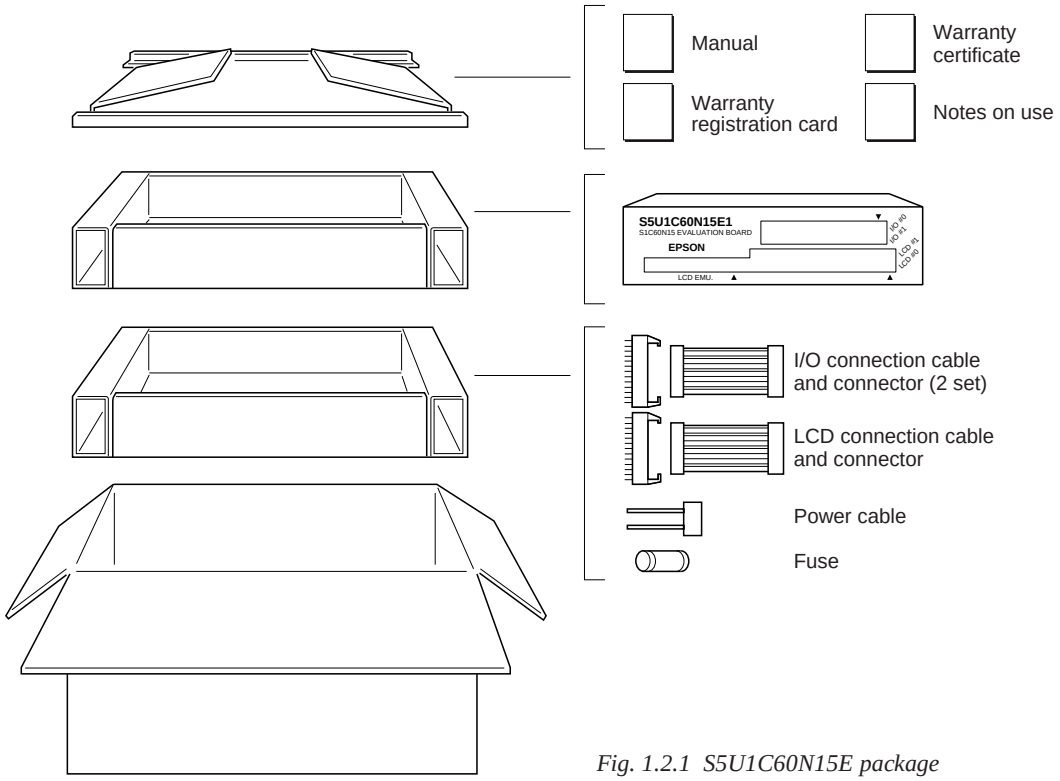


Fig. 1.2.1 S5U1C60N15E package

2 PRODUCT SPECIFICATIONS

The components specifications of the S5U1C60N15E are listed below.

■ S5U1C60N15E

Dimensions:	203 mm (width) × 275 mm (depth) × 65 mm (height) (Including rubber feet)		
Weight:	About 2.04 kg	(main unit only)	
Color:	Cygnus white		
Power supply:	5 V (±10%) DC, 3 A or more	(from external power supply)	
	When connected to the ICE, power is supplied by the ICE.		
Board:	Main board × 1		
	Sub board × 1		
Operating conditions:	Operating temperature	5°C to 40°C	
	Storage temperature	-20°C to 60°C	
	Operating humidity	35% to 80%	
	Storage humidity	20% to 90%	
	Resistance to vibration	Operating	0.25G max.
		Transportation	2G max.
	Resistance to impulse	Operating	1G max.
		Standby	2G max.

■ LCD connection cable

S5U1C60N15E connector:	J3372-P302VE or equivalent
Cable connector:	7960-6500SC
Cable:	60-pin flat cable × 1
Interface:	CMOS interface (5 V)
Length:	About 50 cm

■ I/O cable

S5U1C60N15E connector:	J3433-P302VE or equivalent	
Cable connector:	7950-6500SC	
Cable:	50-pin flat cable × 2	
Interface:	CMOS interface (5 V)	
Length:	About 50 cm	(Two cables are same)

■ Power cable

S5U1C60N15E connector:	MOLEX 5276-03A or equivalent
Cable connector:	MOLEX 5196-03
Other side connector:	(According to power supply specifications)
Cable length:	About 80 cm
Capacity:	5 V DC, 3 A or more

3 NAMES AND FUNCTIONS OF PARTS

This section describes the names and functions of the parts of the S5U1C60N15E.

3.1 Basic Functions

The S5U1C60N15E has the following basic functions:

■ **Program execution (Run function)**

Install the EPROM containing the application program and execute the program.

■ **Interface with ICE**

The S5U1C60N15E can interface with the ICE so that a higher level debugging environment may be established.

■ **Setting hardware options by installing function option and segment option ROMs**

Hardware options, i.e., I/O ports and segments, can be specified by writing option data for the function option created by the function option generator and the segment option created by the segment option generator into EPROM, and installing the EPROM.

3.2 Functions of Parts

3.2.1 Front panel

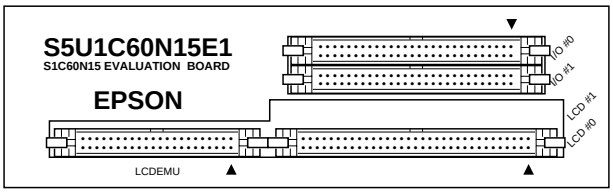


Fig. 3.2.1.1 Front panel

■ **Connectors**

- **I/O #0, I/O #1**
  Connector for the I/O cable. The I/O cable is used to connect the S5U1C60N15E to the target system.
- **LCD #0, LCD #1**
  Connector for the LCD cable. The LCD cable is used to connect the S5U1C60N15E to the target system. LCD #1 cannot be used.
- **LCDEMU**
  Connector for the LCD emulator cable.

3.2.2 Rear panel

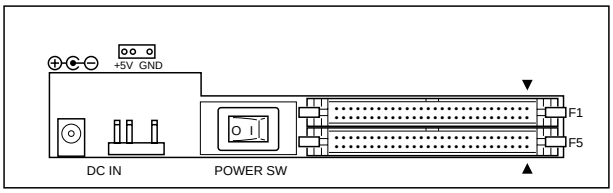


Fig. 3.2.2.1 Rear panel

Note: Be sure to disconnect external power source before connection with ICE, because power is supplied from ICE when you connect S5U1C60N15E to ICE.

■ **Switch**

- **POWER SW**
  This is a switch to turn on (I) or off (O) the external power supply to S5U1C60N15E. (Please turn off the POWER switch when ICE is connected.)

■ **Connectors**

- **DC IN 5 V**
  This is a connector with external power supply source. The external power supply should be in direct current of 5 V for 3 A or more.
- **F1, F5**
  Connectors for the ICE interface cable.

3.2.3 Board (under top cover)

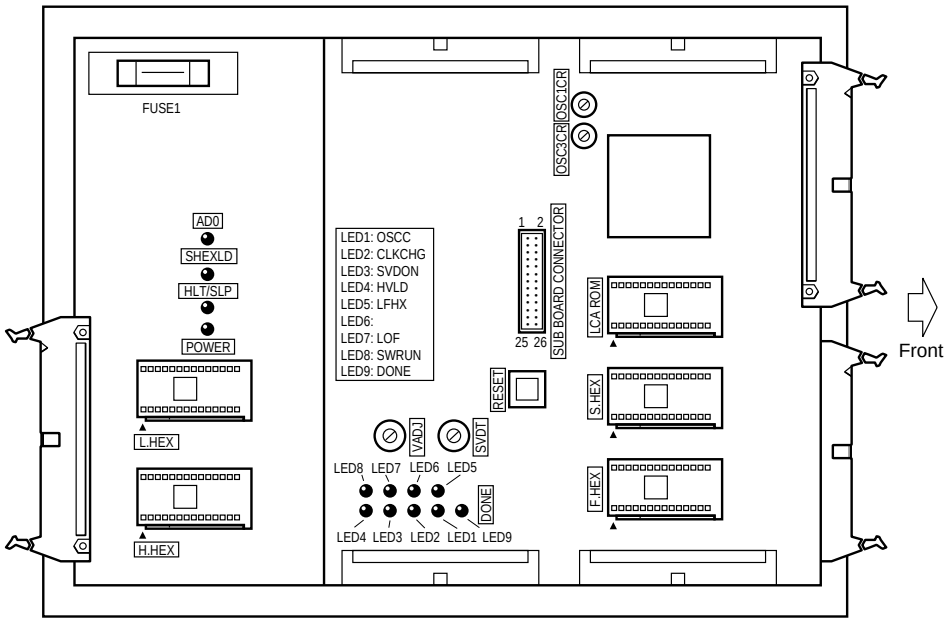


Fig. 3.2.3.1 Layout on the board

■ ROM sockets

- **L.HEX, H.HEX**
  These are IC sockets for target program ROMs. Insert the ROM (L.HEX) containing the 8 low-order bits (I7 to I0) of the machine code into the L.HEX socket, and the ROM (H.HEX) containing the 4 high-order bits (IB to I8) into the H.HEX socket.
- **F.HEX**
  This is the IC socket into which the ROM (F.HEX) is inserted. This ROM includes the function options generated by the function option generator (winfog).
- **S.HEX**
  This is the IC socket into which the ROM (S.HEX) is inserted. This ROM includes the segment options generated by the segment option generator (winsog).
- **LCA ROM**
  This is the S1C60N15 peripheral circuit ROM.

■ Switch

- **RESET switch**
  This switch resets the CPU and starts the target program from page 01H, step 00H.

■ FUSE

- **FUSE1**
  This is 3 A tubular fuse for external power supply, and is blown off by current of 3 A or more.

■ Controls

- **OSC3CR**
  This is the control for varying the OSC3 CR oscillation frequency. This control is effective only when CR oscillation is selected for the OSC3 oscillator type by mask option. The CR oscillation frequency can be checked with an oscilloscope or other instrument by connecting to pin 10 of the sub-board connector.
  Turning clockwise: High frequency
  Turning counterclockwise: Low frequency

- **VADJ**
  This is the control for adjusting the LCD contrast. (Refer to Section 6.2, "Differences from Actual IC".)
- **SVDT**
  This is the control for varying the power supply voltage in simulation to check SVD operation. (Refer to Section 6.2, "Differences from Actual IC".)
  Turning clockwise: Level low
  Turning counterclockwise: Normal

■ LEDs

- **POWER** This LED lights when the S5U1C60N15E goes on.
- **HLT/SLP** This LED lights when the CPU enters HALT status.
- **AD0** This LED indicates the status of the address 0 (AD0) signal. It can be used to check whether or not the S5U1C60N15E works.
- **SHEXLD** This LED lights when segment option data from a personal computer is loaded using the in-circuit emulator ICE. As the result, it can differentiate whether the currently specified segment option is due to the ROM (S.HEX) or has been loaded from a personal computer. Refer to the "S5U1C62000A Manual" in regard to the loading of the segment option using the ICE.
- **LED1 (OSCC)** This LED lights when the OSCC register (address 2FEH • D1) is set to "1" and goes off when the register is set to "0".
- **LED2 (CLKCHG)** This LED lights when the CLKCHG register (address 2FEH • D2) is set to "1" and goes off when the register is set to "0".
- **LED3 (SVDON)** This LED lights when the SVDON register (address 2FFH • D3) is set to "1" and goes off when the register is set to "0".
- **LED4 (HVLD)** This LED lights when the HLMOD register (address 2E6H • D3) is set to "1" and goes off when the register is set to "0".
- **LED5 (LFHX)** This LED lights when function option data from a personal computer is loaded using the in-circuit emulator ICE. As the result, it can differentiate whether the currently specified function option is due to the ROM (F.HEX) or has been loaded from a personal computer. Refer to the "S5U1C62000A Manual" in regard to the loading of the function option using the ICE.
- **LED7 (LOF)** This LED lights when the LOF register (address 2D0H • D0) is set to "0" and goes off when the register is set to "1".
- **LED8 (SWRUN)** This LED lights when the SWRUN register (address 2EEH • D2) is set to "1" and goes off when the register is set to "0".
- **LED9 (DONE)** This LED lights when the S5U1C60N15E has completed configuration at power-on and is ready for debugging. If this LED does not light several seconds after power-on, turn the power off and then on again.

■ Test pins

The status of the following signals can be checked by an oscilloscope or other instrument.

- **SUB BOARD CONNECTOR Pin 10 (OSC3CR)**
  This pin is used to monitor the OSC3 CR oscillation clock.
- **SUB BOARD CONNECTOR Pin 11 (OSC3CE)**
  This pin is used to monitor the OSC3 ceramic oscillation clock.

3.3 S5U1C60N15E I/O, LCD and Sub-board Connectors

Table 3.3.1 I/O #0 connector pins

Pin No.	Signal name	Pin No.	Signal name
1	VDD (+5 V)	2	VDD (+5 V)
3	Cannot be connected	4	Cannot be connected
5	Cannot be connected	6	Cannot be connected
7	R00	8	R01
9	R02	10	R03
11	R10	12	R11
13	R12	14	R13
15	Cannot be connected	16	Cannot be connected
17	Cannot be connected	18	Cannot be connected
19	K00	20	K01
21	K02	22	K03
23	K10	24	Cannot be connected
25	Cannot be connected	26	Cannot be connected
27	K20	28	K21
29	K22	30	K23
31	P00	32	P01
33	P02	34	P03
35	P10	36	P11
37	P12	38	P13
39	Cannot be connected	40	Cannot be connected
41	Cannot be connected	42	Cannot be connected
43	Cannot be connected	44	RESET
45	Cannot be connected	46	Cannot be connected
47	Cannot be connected	48	Cannot be connected
49	VSS (GND)	50	VSS (GND)

Table 3.3.2 I/O #1 connector pins

Pin No.	Signal name	Pin No.	Signal name
1	VDD (+5 V)	2	VDD (+5 V)
3	Cannot be connected	4	Cannot be connected
5	VDD (+5 V)	6	VDD (+5 V)
7	Cannot be connected	8	Cannot be connected
9	V1	10	V2
11	V3	12	V4
13	V5	14	N.C.
15	N.C.	16	N.C.
17	Cannot be connected	18	Cannot be connected
19	N.C.	20	N.C.
21	Cannot be connected	22	Cannot be connected
23	N.C.	24	N.C.
25	Cannot be connected	26	Cannot be connected
27	Cannot be connected	28	Cannot be connected
29	Cannot be connected	30	Cannot be connected
31	Cannot be connected	32	Cannot be connected
33	N.C.	34	N.C.
35	Cannot be connected	36	Cannot be connected
37	Cannot be connected	38	Cannot be connected
39	Cannot be connected	40	Cannot be connected
41	N.C.	42	N.C.
43	N.C.	44	N.C.
45	N.C.	46	N.C.
47	N.C.	48	N.C.
49	VSS (GND)	50	VSS (GND)

Table 3.3.3 LCD #0 connector pins

Pin No.	Signal name	Pin No.	Signal name
1	COM0	2	COM1
3	COM2	4	COM3
5	Cannot be connected	6	Cannot be connected
7	Cannot be connected	8	Cannot be connected
9	SEG0	10	SEG1
11	SEG2	12	SEG3
13	SEG4	14	SEG5
15	SEG6	16	SEG7
17	SEG8	18	SEG9
19	SEG10	20	SEG11
21	SEG12	22	SEG13
23	SEG14	24	SEG15
25	SEG16	26	SEG17
27	SEG18	28	SEG19
29	SEG20	30	SEG21
31	SEG22	32	SEG23
33	SEG24	34	SEG25
35	SEG26	36	SEG27
37	SEG28	38	SEG29
39	SEG30	40	SEG31
41	SEG32	42	SEG33
43	SEG34	44	SEG35
45	SEG36	46	SEG37
47	SEG38	48	SEG39
49	SEG40	50	SEG41
51	SEG42	52	SEG43
53	SEG44	54	SEG45
55	SEG46	56	SEG47
57	Cannot be connected	58	Cannot be connected
59	Cannot be connected	60	Cannot be connected

Table 3.3.4 Sub-board connector pins

Pin No.	Signal name	Pin No.	Signal name
1	VDD (+5 V)	2	Cannot be connected
3	Cannot be connected	4	Cannot be connected
5	Cannot be connected	6	Cannot be connected
7	Cannot be connected	8	Cannot be connected
9	Cannot be connected	10	OSC3CR
11	OSC3CE	12	Cannot be connected
13	Cannot be connected	14	Cannot be connected
15	Cannot be connected	16	Cannot be connected
17	Cannot be connected	18	Cannot be connected
19	Cannot be connected	20	Cannot be connected
21	Cannot be connected	22	Cannot be connected
23	Cannot be connected	24	Cannot be connected
25	Cannot be connected	26	VSS (GND)

4 CABLE CONNECTION

This section describes how to connect the power cable to the S5U1C60N15E, and the S5U1C60N15E to the ICE and the target system.

Note: Turn the power of all equipment off before connecting or disconnecting cables.

4.1 Connection to ICE

The S5U1C60N15E is connected to the ICE by connecting the two interface cables (F1 and F5). Use S5U1C60N15E connectors F1 and F5 with the projections facing outwards. Use ICE connectors F1 and F5 with the projections facing inwards (cable side).
Figures 4.1.1 and 4.1.2 show the external view and connection diagram of the ICE interface cable.

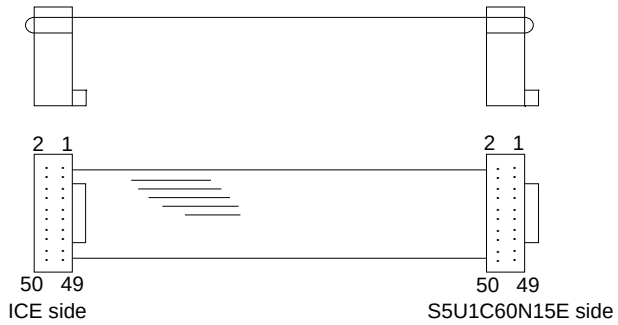


Fig. 4.1.1 External view of the ICE interface cable

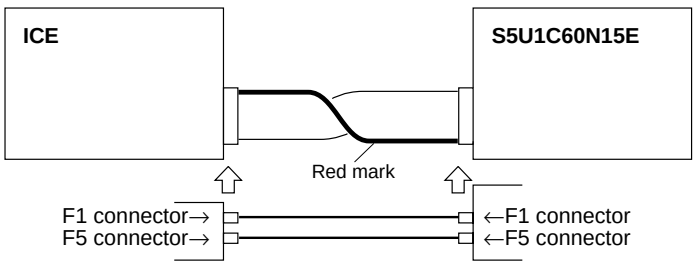


Fig. 4.1.2 Connection diagram

Note: The S5U1C60N15E has an external power input connector for +5 V (V_{DD}) and GND (V_{SS}). Leave these connectors unconnected when the S5U1C60N15E is connected to the ICE.

4.2 Power Cable Connection

When using the S5U1C60N15E on its own, it must be supplied with power (5 V DC, 3 A or more) from an external source through the power cable.
When the S5U1C60N15E is connected to the ICE, power is supplied by the ICE; therefore, the power cable is not necessary. Disconnect the power cable if it is already connected.
Figure 4.2.1 shows the connection of the power cable pins.

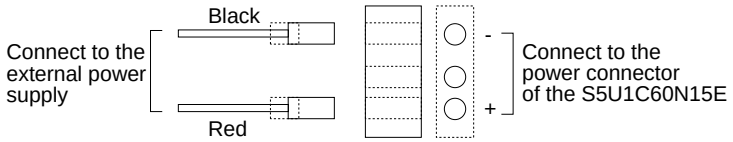


Fig. 4.2.1 Connection of power cable pins

4.3 Connection to Target System

The I/O #0, I/O #1 and LCD #0 connectors are used to connect the S5U1C60N15E to the target system.

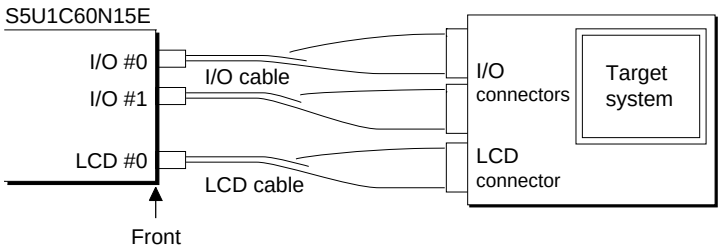


Fig. 4.3.1 Connection of target system

The signals output from the LCD #0 connector are the same as those of the actual IC at the function level. Therefore, the S5U1C60N15E may be connected to the LCD of the target system without any changes.

5 OPERATION METHOD OF S5U1C60N15E

5.1 Preparation

This section describes the common preparation work necessary when the S5U1C60N15E is used by itself and when it is connected to the ICE.
Before doing the following, be sure to turn the POWER switch of the S5U1C60N15E off.

5.1.1 Creation of target system

Mount the LCD panel, keys, and switches on the board to build a target system. Use the I/O connector and LCD connector supplied with the S5U1C60N15E to connect the S5U1C60N15E to the target system. (For the pin layout of each connector, refer to Section 3.3, "S5U1C60N15E I/O, LCD and Sub-board Connectors".)

Note: There is some difference in specifications between the S5U1C60N15E and the actual CPU. Refer to Section 6.2, "Differences from Actual IC" when building a target system.

5.1.2 Creation and installation of ROMs

Create the program ROMs, function option ROM and segment option ROM, and insert them into the sockets of the S5U1C60N15E.

- **Program ROMs (two)**

  The program ROMs contain the application program machine code. Write the HEX files, that are converted into the Intel-HEX format by the HEX converter (hx62) from the object files generated by the linker (lk62), into EPROMs to create program ROMs. Refer to the "S5U1C62000A Manual" for lk62 and hx62. Since two HEX files containing the high-order section (zzzzzzzH.HEX) and the low-order section (zzzzzzzL.HEX) of the machine code are output, two ROMs are created. Insert them into the socket H.HEX and L.HEX under the top cover, respectively.
  These ROMs are not necessary when connecting the S5U1C60N15E to the ICE. In addition, it is necessary to write the object data into the EPROM attaching the offset address as Table 5.1.2.1 according to the type of EPROM that is used.

Table 5.1.2.1 Offset address

EPROM type	Offset value
27C64	0000H (without offset)
27C128	0000H (without offset)
27C256	4000H
27C512	C000H

- **Function option ROM (one)**

  The function option ROM is used to specify function options, such as I/O ports. Create the option ROM from the function option HEX file (zzzzzzzF.HEX) output by the function option generator, and insert it into the F.HEX socket under the top cover.
  This ROM is effective even when the ICE is connected, however, this ROM is disregarded due to the loading of the data from the ICE.

- **Segment option ROM (one)**

  The segment option ROM is used to specify segment output port. Create the segment ROM from the segment option HEX file (zzzzzzzS.HEX) output by the segment option generator, and insert it into the S.HEX socket in the top cover.
  This ROM is effective even when the ICE is connected, however, this ROM is disregarded due to the loading of the data from the ICE.

- **EPROM specifications**

  Use EPROMs with the following specifications:

  Program ROM: 27C64 to 27C512 (250 ns or less access time)
  Function option ROM: 27C64 to 27C512 (250 ns or less access time)
  Segment option ROM: 27C64 to 27C512 (250 ns or less access time)

5.2 Independent Use of S5U1C60N15E

This section describes operation when using the S5U1C60N15E by itself.
The S5U1C60N15E may be used independently by connecting a power supply to it. Use a 5 V DC regulator (more than 3 A) as an external power supply. Connect it with the correct polarity (+ and -).
(Refer to Section 4.2, "Power Cable Connection".)

5.2.1 Power on/off

Before turning the POWER switch of the S5U1C60N15E on, confirm the following:

(1) The power cable is connected correctly.
(2) The target system is connected correctly.
(3) The ROMs have been installed correctly.

After confirming the above items, turn the POWER switch of the S5U1C60N15E on using the following procedure:

(1) Turn the regulator on. If the regulator is a variable-voltage type, set the output voltage to 5 V ±10%.
(2) Turn the POWER switch of the S5U1C60N15E on.

5.2.2 Debugging

When the S5U1C60N15E is used alone, it provides the following debugging function. The method of operation is given below.

- **Program free run**
  When the RESET switch (under the top cover) is pressed, the S5U1C60N15E enters the program run state, and executes the application program from page 1, step 0.

5.3 Operation When ICE is Connected

This section explains the operation and use of the S5U1C60N15E when it is connected to the ICE.
Set up the S5U1C60N15E as follows when it is connected to the ICE:

(1) Do not connect the power supply.
(2) Keep on turning the POWER switch off.

5.3.1 Power on/off

Power to the S5U1C60N15E is supplied by the ICE, and the power is switched on and off by pressing the POWER switch of the ICE. Keep the POWER switch of the S5U1C60N15E off.

5.3.2 Debugging

Debugging is done with the host computer, and the S5U1C60N15E is controlled by the ICE. For the method of operation, refer to the "S5U1C62000A Manual". The S5U1C60N15E can control the following four functions:

(1) RESET input
(2) OSC3 CR oscillation frequency adjustment with the OSC3CR control
(3) Pseudo power supply voltage change with the SVDT control
(4) LCD contrast adjustment with the VADJ control

6 PRECAUTIONS

Take the following precautions when using the S5U1C60N15E:

6.1 Precautions for Operation

- Turn the power of all equipment off before connecting or disconnecting cables.
- To turn the POWER switch of the S5U1C60N15E off, then on again, wait for at least 10 seconds after turning off before turning on.
- When ROMs are inserted into the ROM sockets, lock the lever securely by positioning it horizontally. After the ROMs have been removed from the sockets, lock the lever at the same position above. If the lever is left upright, poor contact may result.
- Confirm that the following ROMs have been installed correctly, then operate the S5U1C60N15E.

(Top panel)	Program ROM	2	L.HEX, H.HEX
(Under top cover)	Function option ROM	1	F.HEX
(Under top cover)	Segment option ROM	1	S.HEX

6.2 Differences from Actual IC

There are some differences in functions between the S5U1C60N15E and the actual IC.

■ I/O

- The response time has been changed by the differences in logic level, output drive capability, and pull-down resistance. The minimum operating voltage is also different from the actual IC.
- The K ports and the P ports of the S5U1C60N15E have a 100 kΩ pull-down resistor which are different from those of the actual IC.
- When the segment terminals are set to DC output, the output signals are delivered with 0 V and +5 V.

■ LCD

- The LCD contrast is adjusted by the VADJ control. However, the contrast level of each actual IC is fixed, so it cannot be adjusted.
- The output drive capability is different.
- If the internal voltage regulator is disabled by mask option, short-circuit the LCD power supply terminals and supply external voltage as shown in Table 6.2.1.

Table 6.2.1 LCD drive voltage supplied externally

1/2 bias		1/3 bias	
Pins to be short-circuited	Voltage to be supplied	Pins to be short-circuited	Voltage to be supplied
V_0–V_3	V_{C2} (Typ. 3.0 V)	V_0	V_{C3} (Typ. 3.0 V)
V_1–V_4	V_{C1} (Typ. 1.5 V)	V_1–V_3	V_{C2} (Typ. 2.0 V)
V_2–V_5	V_{SS} (0 V)	V_2–V_4	V_{C1} (Typ. 1.0 V)
—	—	V_5	V_{SS} (0 V)

■ Power-on sequence differences

The S5U1C60N15E performs configuration and determines the internal state when the power is turned on. Then, it works as the actual IC does. Therefore, the I/O state of the S5U1C60N15E is unstable until configuration is completed. This affects the power-on reset time.

■ Difference in current consumption

It is impossible to evaluate current consumption using the S5U1C60N15E.

■ Function differences

<SVD circuit>

- The SVD function is implemented by varying the apparent power supply voltage with the SVDT control.
- The SVD response time is different from the actual IC. It is necessary to take an appropriate waiting time for getting the SVD result.

<Oscillation circuit>

- For OSC1, 32.768 kHz or 38.4 kHz crystal oscillation can be selected.
  The OSC3 oscillation frequency is fixed at 1 MHz when ceramic oscillation is used. When CR oscillation is used, the frequency can be adjusted approximately from 50 kHz to 1400 kHz using the OSC3CR control mounted on the board.
  Either OSC1 or OSC3 can be selected as the system clock.
- The oscillation stabilization time for OSC3 and OSC1 is shorter than the actual IC. The time from turning the OSC3 oscillation on to switching the system clock to OSC3 should be secured according to the time of the actual IC.
- Use separate instructions for turning the OSC3 oscillation on and for switching the clock from OSC1 to OSC3. The same applies when turning the OSC1 oscillation off after switching the clock from OSC3 to OSC1. The S5U1C60N15E may operate if this processing is performed at the same time. Be sure to use separate instructions according to the actual IC when creating the program.
- The oscillation start and stop times are different from those of the actual IC, because the logic level of the S5U1C60N15E is higher than that of the actual IC.

<Undefined data memory area>

In the S5U1C60N15E, values that are read from unmapped memory areas will be undefined. However, the undefined status differs from the actual IC, therefore pay attention to the memory area when creating programs. Refer to the "S1C60N15 Technical Manual" for the memory map.

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